

The 10th International Conference on EcoBalance (EcoBalance 2012)—Challenges and Solutions for Sustainable Society, November 20–23, 2012, Tokyo, Japan

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Received: 27 April 2013 / Accepted: 4 May 2013 / Published online: 17 May 2013
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1 Introduction

The 10th International Conference on EcoBalance (EcoBalance 2012), organized by The Institute of Life Cycle Assessment, Japan, was held during November 20–23, 2012 at the Hiyoshi Campus of Keio University in Yokohama City. The conference was co-hosted by Keio University and The Ecomaterial Forum, and backed by the Cabinet Office; the Ministry of Education, Culture, Sports, Science and Technology; the Ministry of Agriculture, Forestry and Fisheries; the Ministry of Economy, Trade and Industry; the Ministry of Land, Infrastructure, Transport and Tourism; and the Ministry of Environment. It was also supported by 74 related societies and associations. The Commemorative

Organization for the Japan World Exposition '70 and the Life Cycle Assessment Society of Japan provided monetary aid for the management of the conference. In addition, the event was co-sponsored by the following eight corporations and groups:

Ajinomoto Co., Inc., Hitachi Ltd., Mitsubishi Electric Corporation, Mizuho Information & Research Institute Inc., Pacific Consultants Co., Ltd., TCO2 Co., Ltd., Japan Electrical Manufacture's Association, and the Vinyl Environmental Council.

The International Conference on EcoBalance has been organized every 2 years since 1994. The theme of the conference, originally centered on the life cycle assessment

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(LCA) of products, has expanded in recent years to cover various environmental management indices founded on the life cycle concept and their application in society. The main theme of EcoBalance 2012, the 10th iteration of the conference, was “Challenges and Solutions for Sustainable Society.” Based on the knowledge accumulated on environmental management indices from the past conferences, the objective of the conference was to discuss the use of sustainability indices as key indicators and the application of these indices to various geographies and sectors, especially the Asian countries and regions considered to be the global centers of growth.

The conference attracted 305 domestic and overseas participants including researchers from universities and academic research institutes, policy makers, as well as specialists and consultants from private companies. There were 104 (34 %) overseas participants, 36 (12 %) of whom were from non-Organisation for Economic Co-operation and Development (OECD) countries. Despite concern that the number of participants from other countries would reduce sharply owing to the earthquake in Japan in 2011 and the prevalent political situation, the actual decrease was just 5 %, as compared to 39 % for the conference in 2011. The initiatives that have been offered since the previous conference to encourage participation from abroad, including a discount on the registration fee for participants from non-OECD countries, have helped to establish EcoBalance as an international forum for discussing indices based on the life cycle concepts centered in Asia. The number of participants from their respective countries is indicated below:

Australia (1), Brazil (1), China (4), Denmark (1), Finland (4), France (2), Germany (14), India (2), Indonesia (3), Italy (2), Japan (201), Korea (18), Malaysia (1), Norway (3), the Philippines (1), South Africa (1), Sweden (3), Switzerland (7), Taiwan (13), Thailand (9), Netherlands (3), USA (10), and Vietnam (1).

Table 1 shows the number of presentations made in each session of EcoBalance 2012. There were 2 keynote speeches, 137 oral presentations, and 123 poster presentations during the conference. The oral presentations comprised eight special sessions and nine general sessions, consisting of 87 and 50 research presentations, respectively. The latest research reports were presented in the special sessions, and active discussions took place on subjects including future developments and tasks regarding sustainability indices and case studies, development in material flow analysis (MFA) and sustainable resource management, role of renewable energy in sustainable development, water footprint; sustainable agriculture and food in globalized Asia; environmental management accounting, sustainable agricultural salts management, and material technology for sustainable resource use.

Table 1 Number of presentations in each session

Session category	Session title	# Presentations
Keynote	“FutureCity” Initiative (Hiroto Izumi) The future created by EV comes into view—EV marketplace acceptance and its future prospects as a social system (Yoichi Kishimoto)	2
Special session	Sustainability index and case study	16
	Recent progress in material flow analysis and sustainable resource management	12
	Renewable energy for sustainable development	12
	Water footprint	11
	Sustainable agriculture and food toward globalizing Asia	11
	Environmental management accounting	11
	Sustainable nutrient management	7
	Materials technology for resource sustainability	7
	Input–output analysis	4
	Impact assessment and interpretation	12
General session	Footprint methodology	4
	Environmental management tools	4
	Design and management for the environment	8
	International cooperation and LCA database	4
	Sociology, psychology and education	4
	New challenges in management of supply chain	6
	Waste management and recycling	4
Poster session		123
Total		262

The following sections provide a summary of the opening session, keynote speeches, special sessions, and the closing session.

2 Opening session

Toshiharu Ikaga (Keio University), Chairperson of EcoBalance 2012, made the welcome address. He talked about the main theme, “Challenges and Solutions for Sustainable Society” and the aims of the conference. He said that the sustainability of society is being threatened by population growth, natural disasters, and changes in the global economy, and that we must aspire towards sustainability that considers not only the environment but social and economic factors as well. Ikaga pointed out that establishing a suitable sustainability index and managing society to optimize this index was a challenge. He also mentioned that the aim of the conference was to engage in

discussions on topics relating to sustainability indices and their application in various locations and sectors.

Prof. Matthias Finkbeiner, Chair of the International Advisory Board, was the next speaker. He said that a solution is needed to attain a sustainable society and emphasized the importance of practical applications of methodologies such as LCA and MFA to propagate the life cycle concepts, shifting the focus from “how to do” to “how to use” and converting the methodologies to be used as serious and realistic decision-support tools in both public and private sectors.

Next, Prof. Atsushi Inaba, President of The Institute of Life Cycle Assessment, Japan, provided an overview of the history of the International Conference on EcoBalance. The idea of sustainable development was incorporated into the Rio Declaration at the United Nations Conference on Environment and Development held in 1992 in Rio de Janeiro, Brazil. Prof. Inaba said that the inaugural International Conference on EcoBalance was held in 1994 in response to the work started in 1993 by the International Organization for Standardization (ISO) to standardize LCA methodologies. He also pointed out that the scope of the conference had broadened from LCA methodologies for ecomaterial researchers to indices for a sustainable society, production, and consumption.

3 Keynote speech

3.1 “FutureCity Initiative”: Dr. Hiroto Izumi

The first keynote speech was made by Dr. Hiroto Izumi, then Special Advisor to the Cabinet, Government of Japan, on the FutureCity Initiative. He talked about the initiatives of the Japanese government regarding the future vision for an environmental city that he had helped to promote during his previous appointment as Chief of Cabinet Secretariat, Regional Revitalization Bureau.

The FutureCity Initiative was started by the Japanese government as one of its long-term growth strategies. The aim of the project is to pursue the harmonization of three values—environmental value, social value including measures for the aging population, and economic values such as the creation of new industries—in order to resolve concerns affecting Japan’s future including those on urbanization, an aging population, and environmental issues such as CO₂ emissions reduction. The project has already scripted success stories in several cities and aims to establish a new vision and prospect for covering more cities as well as to share the knowledge gained through these activities globally, especially in other Asian countries.

The project comprises five model cities outside the areas affected by the Great East Japan Earthquake, including Shimokawa-Cho (Hokkaido), Kashiwa-Shi (Chiba Prefecture),

Yokohama-Shi (Kanagawa Prefecture), Toyama-Shi (Toyama Prefecture), and Kita Kyushu-Shi (Fukuoka Prefecture), as well as six coastal cities within the areas affected by the earthquake including Matsushima-Shi (Miyagi Prefecture) and Kamaishi-Shi (Iwate Prefecture). In just over a year since the selections, considerable progress has been made. For example, in Kita Kyushu-Shi, trials have commenced for “smart meters,” which help to vary electricity pricing based on demand and lead to considerable energy saving. Toyama-Shi is currently redesigning its public transport system including reviving light rail transit to resolve the problem of a hollowing city center caused by a car-dependent society and to respond to the future needs of the aging population. Shimokawa-Cho is working to revitalize a commercially viable forestry industry; Higashi Matsushima-Shi has introduced solar panels to temporary housing units; and Kamaishi-Shi is developing a network for the provision of medical care, health, and welfare services.

To assist the cities selected under the FutureCity Initiative, the government has delegated specialists, allotted special budgets, and made enabling legislative reforms. In addition, it hosted the inaugural International Forum in February 2012 to share best practices from cities around the world. At the United Nations Conference on Sustainable Development (Rio+20), held in June 2012, the Japanese government announced the “Green Future Initiative,” which aims for a transition to a green economy, establishment of a robust society, and promotion of the ideal of a future world comprising environmental cities.

3.2 The future created by EV comes in view—EV marketplace acceptance and its future prospects as social system: Mr. Yoichi Kishimoto

The second keynote speaker was Mr. Yoichi Kishimoto, who is in charge of technology marketing at Nissan Motors Co., Ltd. His speech, entitled “The future created by EV comes in view—EV marketplace acceptance and its future prospects as social system,” covered the possibility of a future society shaped by the electric vehicle (EV).

The negative impacts of motor vehicles include traffic jams, accidents, challenges for energy security, and global warming. Of these, the issues of energy security and global warming can be solved by the use of EVs. Compared to the energy conversion rate of 20 % for internal combustion engines, EVs, and fuel cell vehicles (FCVs) can achieve an energy conversion efficiency of 80–90 %. Moreover, it is rational to leverage renewable energy such as solar and wind energy by conversion to electricity. It is estimated that new cars in 2050 must produce 90 % less CO₂ emission than today. For this, EVs and FCVs will need to comprise the mainstream, with energy coming from renewable sources.

Nissan's EV, called LEAF, has achieved zero emission. It is energy efficient, comes complete with telematics systems, runs quietly, and has superior running performance. High customer satisfaction has helped to sell about 37,000 cars in less than 2 years. Nissan is also pushing for the development of an EV recharge infrastructure; long distance use on speedways has already increased following the installation of rapid recharge stations.

The EV is expected to contribute to the future social system. Of the 90 % of EVs not running at any given time, the difference between average recharge energy and energy required for the next trip—approximately 50 % of the total EV battery capacity—can be used to enable peak shaving. Furthermore, by connecting the EV to the house electrically and enabling data connection, it will be possible to conceive of an energy management system covering an entire community through cloud infrastructure. The result of simulations based on analysis of EV usage patterns and domestic solar electric generation and energy use shows that the use of solar electricity would increase from 40 to 70 %, and dependence on grid electricity decrease from 75 to 50 % by charging EVs using solar electricity during the day and using the stored energy at night. A proof-of-concept test conducted at the Nissan Technical Center North America, Inc. has shown that peak shaving of 8.5 % is possible for a whole building. It is possible to conceive of an independent distributed energy community into which EVs are embedded, and Nissan is involved in various projects such as the Yokohama Smart City Project to advance this concept.

4 Special sessions

Oral presentations included eight special sessions and nine general sessions. The following sections summarize the special sessions.

4.1 Special session 1: Sustainability index and case study

The aim of the first special session was to reconsider the definition of sustainability and its assessment methodologies, and to present case studies in which the sustainability of products and services—particularly in the field of buildings and cities—were assessed. During EcoBalance 2012, a total of four slots were allocated over the course of 2 days, and a total of 14 presentations were given, including one by an invited speaker.

On November 21, the first day of the conference, presentations were given on methodologies for evaluating sustainability indices using example case studies as they apply to corporate management. Mr. Marc-Andree Wolf (Maki Consulting) introduced the “Decoupling Indicator,” an assessment methodology under development, and provided its definition

and criteria. Mr. Mark Goedkoop (PRé Consultants) gave a presentation on the “Social Matrix,” which has been developed as a practical social impact assessment technique, referencing a case study that used this technique. Invited speaker Dr. Pin-Chih Wang (National Taipei University) reviewed existing indices for people's welfare and happiness and proposed an integration of these indices using the analytic hierarchy process. Ms. Justine Vichard (France Telecom Orange) reported on a case study involving an assessment of telemedicine services in Senegal via the “Gross Social Feel-good Index,” a monetary social impact index developed by NTT Corporation. Prof. Damien Giurco (University of Technology, Sydney) gave a presentation on the sustainability and long-term forecast of mining and energy resources, including strategies for both production and consumer countries. Prof. Cassia M. L. Ugaya (Federal Technological University of Parana) introduced a case study in which social LCA was applied to coco soap manufacturing staff. Mr. Jan Paul Lindner (Fraunhofer Institute) reported on a case study in the airline industry where process LCA and I-O LCA were used to compare environmental accounting practices and to support decision making. Amid the increasing demand for sustainability indices, discussions on methodologies and case studies indicated that acceptance by society and practicality of implementation play key roles.

On November 22, the second day of the conference, case studies were presented in which buildings and cities were assessed based on the life cycle concept. Prof. Yasushi Asami of The University of Tokyo gave a presentation entitled “Evaluation of residential environment and its indicators,” introduced basic ideas for evaluating our residential environment, and talked about applicable case studies. He also pointed out the importance of changing the choice of index, depending on the object and objective of the evaluation, and of continuously validating whether there is room for improvement in the selected index. In the seven presentations that followed, research results in the environmental performance assessment of buildings and cities and the evaluation of citizens' quality of life (QOL) were reported. All research employed an academic approach that leveraged findings from various fields of study, including environmental engineering, economics, geomatics, and information science. The special session ended with the entire audience's concession that factors, causality, and definitions affecting sustainability and QOL will require further in-depth discussions, and, similarly, methodologies for integrating acquired information will require further considerations and discussions.

4.2 Special session 2: Recent progress in material flow analysis and sustainable resource management

Owing to recent increases in resource requirements associated with economic growth in developing countries, an

acute global interest in “sustainable resource management” has emerged. In this special session, 12 presentations, including one by an invited speaker, were given. The presentations mainly focused on MFA as a technique to analyze resource demand structure, and on the latest research trends in LCA. The audience engaged in animated discussions throughout the three sessions that spanned a wide body of knowledge including resource economics, material science, and environmental science, MFA, and LCA.

The first session included presentations revealing the latest research results, such as flow and stock analysis of steel using dynamic MFA and analysis of building stock using the Geographical Information System, or GIS. Dr. Wang, for example, analyzed steel stock in Asia for the period 1900–2010 using dynamic MFA, showing that steel stock reached 8.8 billion tons in 2010. If the growth rate is sustained, China would reach a per-capita steel stock level similar to those of advanced countries today (10–13 t/cap) by 2024–2040, and India and other countries by 2060–2080. The appropriate re-use of scrap metal is required to reduce greenhouse gas emissions; further, it is clear that the importance of MFA will increase in the future. A presentation was also given on steel flow analysis (C2-02) on shipbreaking of old ships in Bangladesh. These presentations suggest a growing interest in MFA for building materials that support the future economic development of the Asian region. Furthermore, The University of Tokyo and Nagoya University gave presentations on their attempts to estimate the steel stock of buildings using general-purpose GIS, such as the Google Maps, and synthetic aperture radar images, calling attention to the new realm of MFA research.

There were four research presentations on methodologies, such as MFA, including one by an invited speaker, Ms. Laura Schneider (Technische Universität Berlin), who presented research results for the medium-term supply and demand analysis of copper. Another presentation (C2-06), related to research that forecasted future copper demands by considering various demand scenarios for next-generation motor vehicles, also dealt with copper. Other presentations included LCA research that considered the reduction in ore grade during mining (C2-07) and research on the evaluation of recoverability of metals using a combination of MFA techniques and thermodynamic analyses. Currently, numerous studies are underway in the area of forecasting the supply and demand of natural resources; also emphasized was the important role of the International Conference on EcoBalance as a forum to exchange research information.

During the third session, four studies that dealt with more specific case studies were presented, including the accumulation of domestic electric appliances in society, called an “urban mine” (C2-09); emissions associated with mobile phones in China (C2-10); an international supply chain analysis of metal resources used in clean technologies

(e.g., neodymium; C2-11); and a scenario analysis for the introduction of next-generation motor vehicles (C2-12). Research that examines the tradeoff between resources and environmental problems brought about by the international supply chain or clean technologies that respond to different social images, raises important questions.

4.3 Special session 3: Renewable energy for sustainable development

In the past, broad discussions have centered on renewable energy initiatives from the perspectives of the sustainable use of energy resources for the future and as a countermeasure for global warming. These discussions address the problem of development, suitable operations, strategies for social acceptance, and efficient implementation of component technologies. Future discussions on renewable energy will need to consider the strategic implementation of concrete component technologies and the widespread use of renewable energy in developing countries, especially in Asia. As part of these discussions, a life cycle assessment is needed for these technologies and systems as well as for the consumer activities that use them.

With these objectives and aforementioned keywords in mind, the component technologies required to implement renewable energy technologies, initiatives in developing countries, and the effects of social systems that contribute to the implementation of renewable energies were discussed. Kiyoshi Dowaki (Tokyo University of Science) served as the session organizer, and 11 presentations with 12 invited speakers (with the exception of one cancellation) from Indonesia, the Philippines, Japan (two speakers), USA (two speakers), Sweden, Taiwan, Malaysia, Thailand, Germany, and Norway were given.

The summaries of presentations by invited speakers are provided below. Prof. Maric Radenka (University of Connecticut) introduced a proof-of-concept study using a 400 kW solid oxide fuel cell (SOFC) situated inside the University of Connecticut campus, the fuel for which was a synthetic gas made in a downdraft gasifier using food scraps obtained from the campus cafeteria. The presentation illustrated a case study for a biomass gas SOFC system that would contribute further to the environment. This case study is very meaningful to Japan for the following reasons: it differs from the 1 kW domestic fuel cell that Japan is aiming to realize; operations of the said case study included a material-based approach for the removal of sulfur and tar; and the presentation provided the current status of development of the technology for mid- to small-scale implementations. Another presentation discussed mobile devices that use biogas for fuel, introducing the possibility of combining biomass with fuel cell technology.

Presentations from developing countries, especially those in the Asian region, included the use of biodiesel, gasification

power generation using grain husks, and a recycling system aiming to prevent the contamination of bean curd (tofu) by wastewater. Also discussed was the need to consider bioenergy's impact on the climate.

One observation from this special session signified an increase in the number of assessments that incorporated concrete technologies, facts, and field investigations. However, the result of the LCA evaluation for these cases denoted an ambiguous system boundary, and there were cases where energy or the CO₂ unit load was not specific to the target region, which made unconditional comparisons between similar research results difficult. Thus, integrated knowledge and insight are needed to address such issues in the future.

4.4 Special session 4: Water footprint

Global attention has shifted to the imbalance between water demand and water supply. This is due to the increasing water demand associated with an increasing population and changes in people's lifestyles. To quantify the effect of water use and consumption associated with products and services and to achieve sustainable use of water resources, the development of various techniques and application studies on the water footprint have accelerated in recent years, including standardization by ISO. The purpose of this special session on the water footprint was to share the latest activities in various initiatives and the status of international standardization, to discuss state-of-the-art development on inventory databases and methodologies for the water footprint, to discuss their availability in practical cases, and to identify problems to be solved. There were 11 oral presentations, including two invited speakers and one poster presentation.

In the session on standardization and methodology development, Mr. Sebastien Humbert (Quantis), who is the convener of the ISO standardization working group on the water footprint, introduced recent discussions and progress in international standardization. Ms. Anna Kounina (Quantis) reviewed existing methods on inventory impact assessment as a result of a discussion at the WULCA (Water Use LCA) group of the United Nations Environmental Programme (UNEP)/SETAC Life Cycle Initiative. Masaharu Motoshita (National Institute of Advanced Industrial Science and Technology) proposed a new water footprint concept that incorporated indirect water consumption due to land use, and Ms. Bettina Joa (Pforzheim University) presented a methodology and an application for managing water use in corporations related to business activities.

In the session dedicated to inventory databases and case studies, Mr. Sebastien Humbert (Quantis) introduced Quantis's database for water footprint analysis, which incorporates water data with Ecoinvent. Dr. Kiyohara Tahara (National Institute

of Advanced Industrial Science and Technology) gave a presentation on the development of an inventory database for environmental analysis corresponding to the water footprint. Several case studies were presented, including a focus on automobiles by Mr. Markus Berger (Technische Universität Berlin) and Mr. Hyung Chul Kim (Ford Motor Company), agricultural products by Ms. Minjung Son (SMaRT ECO Co., Ltd), and bioethanol by Mr. Shinatiphkorn Pongpinyopap (Kasetsart University). In his presentation, Mr. Markus Berger proposed a new concept on impact assessment methodology that considers regional water cycle effects. In the context of communication with general consumers, Prof. Shinya Matsumoto (Yokohama National University) gave a presentation on an education program at school using the water footprint.

Inventory databases currently being developed in Europe and Japan seem to satisfy the international standard requirements. As shown in a review on methodologies on the water footprint, various impact assessment methodologies applicable to practical cases have been developed. On the other hand, practical cases presented in this session showed that the results would depend on the choice of background database and system boundary. This indicates that more discussions for interpreting the results of case studies are necessary for advancing the methodology of the water footprint. With regard to methodology development, new concepts for impact assessment that consider the effect of land use and regional water cycles on the availability of water, and that differentiate between the availability of water depending on water sources (rain, surface and ground water) have been proposed for the further improvement of assessment methodology. Water footprint is a new type of methodology (part of LCA but with several specific and crucial distinguishing aspects), therefore the unification of terminology, the system boundary to be considered, and ways to communicate this to the public were recognized as future tasks to advocate further progress.

4.5 Special session 5: Sustainable agriculture and food for globalizing Asia

Agricultural and food systems play fundamental roles in developing a sustainable Asia. From this standpoint, this session discussed methodologies and applications of LCA for agriculture and food, with a special focus on the Asian region, which has recently increased its presence. A total of 11 presentations were given across three sessions.

In the first session, the invited speaker Dr. Rattanawan Mungkung (Kasetsart University) reported on the past initiatives relating to LCA of agriculture and foods in Thailand, recent trends in the carbon and water footprint, and the current state of the LCA network in Thailand and Asia. Next, Dr. Chun-Youl Beak (Ajou University) presented a

greenhouse gas (GHG) emission calculation tool for dairy farms in South Korea. Further, Dr. Yasunori Kikuchi (The University of Tokyo) proposed an integrated scenario analysis model to evaluate ethanol production from sugarcane also presented a case study of Ieshima Island, Okinawa Prefecture.

The topics of the second session were impact assessment and databases. Mr. Jan Paul Lindner (Fraunhofer IBP) proposed an integrated biodiversity assessment methodology for LCA. While he focused mainly on a general framework, he summarized critical issues in the impact assessment of land use change. Prof. Olivier Jolliet (University of Michigan) proposed a new impact assessment method for pesticides and explained the results of this impact on human health. Dr. Sebastien Humbert (Quantis) introduced an ambitious project to develop the World Food LCA Database. Then, Kiyotada Hayashi (National Agriculture and Food Research Organization) compared calculation methods for GHG emissions from agricultural inputs with assessment methods based on emission coefficients derived from the national IO table, to a method using the Japan Agricultural Life Cycle Assessment database. He suggested that the former may cause overestimation.

In the third session, three papers on LCA of rice were presented. Dr. Rolf Frischknecht (treeze) compared the Ecological Scarcity Japan and its application to conventional, environmentally friendly, and organic paddy rice cultivation. Next, Dr. Naoki Yoshikawa (Ritsumeikan University) demonstrated that a DeNitrification–DeComposition model, modified by the National Institute for Agro-Environmental Sciences for use on paddy rice, was useful in applying LCA to paddy rice. Dr. Shingo Hokazono (National Agriculture and Food Research Organization) focused on weed control, which is a critical management practice in organic cultivation, and demonstrated a technique for visualizing how the choice of weed control methods can impact the environment.

We enjoyed active and productive question-and-answer sessions as a whole, although we realized that the consistency between presentations and questions is important for successful discussions. The activities during this special session will be passed on to the LCA Agri-Food Asia Initiative.

4.6 Special session 6: Environmental management accounting

The theme for this special session was the coordination between material flow cost accounting (MFCA) and LCA or life cycle costing (LCC). The session commenced with invited speaker Prof. Dr. Bernd Wagner (University of Augsburg, Germany) whose presentation was entitled “Controlling Resource Flows for a Sustainable Society.”

He examined case studies and the development of techniques for MFCA applied to Germany, Japan, Malaysia, and South Africa. In particular, there were presentations of different techniques that extended MFCA, including one that starts with a process within a corporation which then evolves to include a supply chain; one in which integration with information on environmental considerations is strengthened by linking MFCA with the carbon footprint and life cycle inventory; and one that integrates resource efficiency and the reduction of GHG.

For example, one presentation on the development of an I/O inventory database for GHG in China leveraged the accumulated LCA research results, indicating that coordination between business decision-making systems—such as MFCA and LCA—is now a possibility. Next were presentations related to the linking of cost information with environmental impact information in a manner similar to MFCA. One presentation centered on the application of LCC in the livestock industry; another presentation proposed a sustainable management model based on a case study in Korea; and another concerned the development of technologies that contribute to cost assessment of environmental impact and sustainability in relation to the potential use of management information toward the reduction of the environmental impact from the viewpoint of corporations.

The discussions from this session can be summarized as follows. The numerous case studies using MFCA were helpful in realizing improvements in resource efficiency in business practices, owing to the support provided by cost information based on resource efficiency for decision making. For better consideration of the environment, however, the deployment of MFCA techniques that leverage LCA analytical outcomes is both effective and necessary. In the attempt to achieve this, it has been confirmed that matching the homogeneity of MFCA and LCA data—specifically in terms of data precision, individuality of corporations, and scope of data—is an issue that must be addressed. In conclusion, the usefulness of the collaborative research that was discussed in this session has been fully recognized by both MFCA and LCA experts alike. The consensus is that the exchange of research information is critical and can lead to greater results. An extremely meaningful discussion was held for future research in both environmental management accounting and LCA.

4.7 Special session 7: Sustainable nutrient management

The global population is expected to reach nine billion by 2050, and the sustainable use and management of agricultural salts is recognized as a critical issue in supporting future human food consumption and minimizing the use of fossil fuels as a source of energy and material. In this special session, discussions involved various assessment techniques

as well as their outcomes and issues toward the sustainable management of agricultural salts founded on the life cycle concept. Discussions included using fertilizers in agricultural production; using agricultural scraps and wastes; MFA and substance flow analysis of mineral nutrients; and developing resource-efficient technologies. Kazuyo Matsubae (Tohoku University) and Dr. Rokuta Inaba (National Institute for Environmental Studies) organized the sessions. There were seven presentations, including three invited speakers from Vietnam, Taiwan, and Japan. A summary is provided below.

Dr. Tien Minh Tran (Soils and Fertilizers Research Institute, Vietnam) and Dr. Shinichiro Mishima (National Institute for Agro-Environmental Sciences) focused on agricultural salts (phosphorus, nitrogen, and potassium) present in soil in relation to agricultural production. They undertook flow analyses based on actual measurements, and shared knowledge and insight into the effective use of resources in the future. Dr. Gwo-Dong Roam (Environmental Protection Administration, Taiwan), Dr. Kenji Okano (Osaka University), and Prof. Akio Kuroda (Hiroshima University) undertook analyses for harvesting phosphorus during the wastewater treatment process from the dimensions of both technology and economy, and they pointed out that such harvesting plays an important role in sustainable phosphorus resource management.

Kazuyo Matsubae (Tohoku University) developed a phosphorus resource cycle model based on an inter-industrial relationship model, and she demonstrated the outcome of analyzing the ripple effect when phosphorus is harvested from various unused resources and is recycled. Finally, Prof. Masari Yarime (The University of Tokyo) provided a governance perspective in relation to how policies and regulations should be designed and how stakeholders should be involved in the effective use and management of agricultural salts, taking up phosphorus as an example.

Research presentations covered the usage phase first, followed by the harvesting and recycling phase now and in the future. Then, the presentations covered the model analysis using life cycle concepts and finally governance. Comprehensive, lively discussions based on these presentations took place throughout.

4.8 Special session 8: Materials technology for resource sustainability

Twenty years have passed since the term “ecomaterial” was first coined. During this period, various materials and process technologies that contribute to the reduction of the environmental load have been developed, and manufacturing and disposal processes that consider the impact on the environmental load over the entire life cycle of a product have become commonplace. Despite such endeavors, environmental problems persist; in fact, they have worsened. At

this stage, we must reconsider Japan’s contributions to the resolution of environmental issues in the area of material science, where Japan still maintains its competitive edge in the world. In this special session, discussion topics included the future direction of “ecomaterial” and the establishment of new milestones to further reduce the environmental load in such a time when it is common to develop materials by considering not only cost and performance, but also the environmental load.

In their presentations during the first part of the morning session, three leading researchers in the field of ecomaterials introduced the latest information on ecomaterials, including social, economic, and academic backgrounds as well as a new concept of ecomaterials and its potential. Global leading expert in ecomaterials, Dr. Kohmei Halada (National Institute for Materials Science), delivered a presentation entitled “What is the Ecomaterial in this 21st Century?” From a resource depletion perspective, he identified the goals that must be accomplished in the field of material science in order to move toward a sustainable society in the twenty-first century. He indicated that in the future, it will be important to focus not only on resource flow but also on the use of accumulated resources in the advanced society; moreover, he pointed out that traditional life cycle models cannot be applied to product design and systems. Following his introduction of element strategy, he explained the importance of using those resources that are abundant nearby. Prof. Yuichi Moriguchi (The University of Tokyo), who has contributed significantly to government environmental policies, gave a presentation entitled “Recent Progress in Sustainable Management of Material Resources,” and noted the progress in the research of sustainable resource management and policies, focusing on trends in discussions in relation to Japanese government policies and the panel of the UNEP. The international collaboration of expert groups, he pointed out, has not only contributed to academic progress but has also played a critical role in bridging scientific knowledge and insight as well as policy making. Leading material researcher Dr. Yoshikazu Shinohara (National Institute for Materials Science) gave a presentation entitled “For Whom and for What Ecomaterials Are?” He focused on the current state of increasing GHG despite the widespread use of highly environmentally efficient products, including ecomaterials, and he proposed that in order to reduce GHG, it is important to start thinking from the end users’ perspective—for example, how they use materials and products—and not solely from a product development perspective.

In the second part of the afternoon session, four studies in material science that contribute to the reduction of the environmental load were introduced, including a presentation by invited speaker Dr. Masatoshi Iji (NEC Corporation). Active discussions across various fields of the participants’

expertise were held, including the poster presentations that took place on November 22.

5 Closing session

During the closing session on November 23, poster awards were presented first. Posters for the award were chosen through a preliminary review based on abstracts submitted prior to the deadline, and a secondary review based on the poster presentation session on November 22 (there were 140 candidate posters, including cancelations). The award was given to the following three posters, which were deemed superior. The authors received an award certificate, a commemorative shield, and prize money.

- Shanna Shaked, Damien Friot, Julia Steinberger, Sebastien Humbert, Manuele Margni, Cedric Wannaz, Stefan Schwarzer, and Olivier Jolliet:

Health impacts of trade: global model Integration of life cycle impact assessment + input–output

- Sayuri Tanaka, Yasunori Kikuchi, and Masahiko Hirao:
Risk management based on trade-off analysis by information sharing among stakeholders involved in the printing industry
- Takeshi Morimura, Kazuyo Matsubae, Kenichi Nakajima, Rokuta Inaba, Keisuke Nansai, and Tetsuya Nagasaka:

International material flow analysis on phosphorus related to agricultural product consumption

At the end of the closing session, Ikaga, the Executive Chairperson of EcoBalance 2012, delivered his closing address, during which he expressed gratitude for the active discussions held during the conference, encouraged the continued expansion of exchanges established during the conference, and called for a reunion during the next conference to be held in 2014.